SOME NEW EXPERIMENTS ON THE NATURE OF DISCRIMINATION LEARNING IN THE RAT

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Despite considerable experimental work and extensive debate, the prospect of resolving the Spence-Lashley controversy over the nature of discrimination learning has seemed remote. Neither of the opposing theories is as rigorously formulated as might be desired and each provides loopholes through which its adherents can escape the consequences of unforeseen results. Consequently it is almost impossible to design an experiment which will be generally acceptable as a crucial test, and one can only hope to get at the processes in question by a series of successive approximations. Critical reactions to experiments already performed do, however, indicate the direction which further research must take. The investigation reported here represents an attempt to get at the fundamental issues involved in the controversy while at the same time observing the restrictions and limiting conditions which have been imposed by the adherents of both theories in their attempts to deal with unfavorable results. There is a danger, of course, that the acceptance of these limitations will narrow the scope of the investigation to such an extent that the operation of important mechanisms will be concealed. For example, an experiment limited to the use of position and brightness cues will tell us nothing about perceptual organization in situations which involve a number of visual variables, such as size and form. Nevertheless, none of the restrictions which we have employed can be objectionable in principle to either of the contending parties, at least insofar as their views are now formulated, and for this reason experiments of this kind which we have designed may serve a useful purpose.

I. THE PRE-SOLUTION PERIOD

From the point of view of non-continuity theory, the rat responds abstractively or selectively to the 'welter' of stimuli presented by a discrimination problem (5, 6, 7). For example, when a rat in the Lashley apparatus jumps to a white card which is situated to the left of a black card, what it learns depends upon the 'hypothesis' or perceptual organization which has guided the response. Under the egis of a left-going hypothesis the animal learns something about the correctness or incorrectness of the spatial aspect and nothing about brightness, while the reverse is true if the animal has been 'set' for brightness. According to continuity theory, on the other hand, *all* discriminable features of the stimulus situation which 'impinge upon the sensorium' develop excitatory or inhibitory properties as a consequence of the jump, and from this point of view *both* the spatial and brightness features of the card may be expected to acquire functional significance for the animal (10, 11).

This theoretical disagreement led to the design of the cue-reversal experiment which seemed at first to provide a crucial test. If the significance of the relevant cues is reversed during the 'pre-solution period'—that is, before the animal has begun to make 'hypotheses' about them, and while it is still responding in terms of irrelevant features of the situation—learning, according to non-continuity theory, should not be retarded. If, however, all discriminable features acquire functional significance from the very beginning of the experiment, as the continuity theorists maintain, reversal should retard learning. In order to interpret the results of such experiments, it is necessary to find an independent criterion for the duration of the pre-solution period, and it is here that difficulty arises.

If we adopt the statistical criterion of 'hypothesis' which was advanced at one time by Krechevsky (5) the pre-solution period may be considered to end when the animal begins to respond systematically to the relevant cues, *i.e.*, when its error score begins to deviate significantly from the chance level. But in order to account for the apparent continuity revealed in the data of McCulloch and Pratt (9) and in the behavior of his own 40-trial group, Krechevsky (6) has found it necessary to abandon this criterion and to resort to *ad hoc* interpretation. He now takes the position that an animal may actually be making 'hypotheses' about a relevant stimulus feature *before* it begins to show a systematic tendency to respond in terms of that feature. Recently, Spence (12) and Ehrenfreund (2) have demonstrated that the rat learns about relevant cues (brightness or form) even during a period of systematic response to an irrelevant cue (position). Krechevsky has not commented on these results, but his most likely rejoinder is indicated in previous writings: "... in some instances the animal might be reacting to an 'irrelevant' set of discriminanda as well as to the relevant set, and would thus be learning something about the final solution even while seeming to be carrying out an 'irrelevant' hypothesis" (6, p. 108). Krechevsky's criterion of the duration of the pre-solution period now becomes the cue-reversal experiment itself, which of course is thus deprived of crucial significance.

This ambiguous state of affairs suggests the desirability of a fresh approach to the problem. An experiment must be designed which requires no assumption about the exact point at which the animals adopt one hypothesis or another or look in one direction or another. The receptor-orientation problem is readily solved, as Spence (11) suggests, by the exclusive use of brightness and spatial cues. The more difficult 'hypothesis' problem may perhaps be solved if we shift our attention from relevant to irrelevant cues. According to non-continuity theory, if an animal masters a brightness discrimination under conditions of spatial alternation, it has learned either (a) nothing at all about the adequacy of any given spatial hypothesis or (b) that the spatial hypothesis is inadequate. The experiment to be reported here requires only these assumptions.

The procedure employed is illustrated schematically in figure 1. In the first part of the experiment animals A and B learn a brightness discrimination (jumping apparatus), with white card positive and black negative. Contrary to the customary procedure, however, each card does not appear equally often on each side. For animal A, as figure 1 shows, the white card appears at the right on 80 per cent of the trials and at the left on 20 per cent of the trials. This position bias is reversed for animal B. After the discrimination is mastered, the problem is shifted to require a position reaction. In this second part of the experiment both animals must learn to jump to the right-hand window irrespective of the brightness of the card which appears there on any trial. Both animals master the brightness discrimination at the same rate. How will their performance compare in the second part of the experiment?

Continuity theory should lead us to expect that the two animals will show unequal rates of mastery in Part 2. When the problem is shifted from brightness discrimination to position reaction, the differential position reinforcement in the first part of the experiment should influence performance. Animal A, which has been reinforced more frequently on the side subsequently to be positive, should excel animal B, which has been more frequently reinforced on the side subsequently to be negative. Non-continuity theory suggests, on the other hand, that neither animal will develop a position preference during the brightness training, and if pre-experimental position preferences are comparable the two animals should learn at the same rate in Part 2. It may be that neither animal will adopt a position hypothesis, before the brightness discrimination is mastered, in which case the differential reinforcement should have no effect. If the animals do adopt position hypotheses, they can learn only that these hypotheses are incorrect. It might be suggested, of course, that animal A is more likely than animal B to hit upon a right-going hypothesis in the first stage of the experiment. If so, we should expect the performance of animal A to be *inferior* to that of B in the second stage. A would then be more likely to learn about the *inadequacy* of the right-going hypothesis and therefore *less* likely, if anything, to adopt this hypothesis when the problem is shifted. The two theories, then, lead to different predictions. Continuity theory predicts superior performance for animal A, while non-continuity theory predicts either no difference or superior performance for animal B.

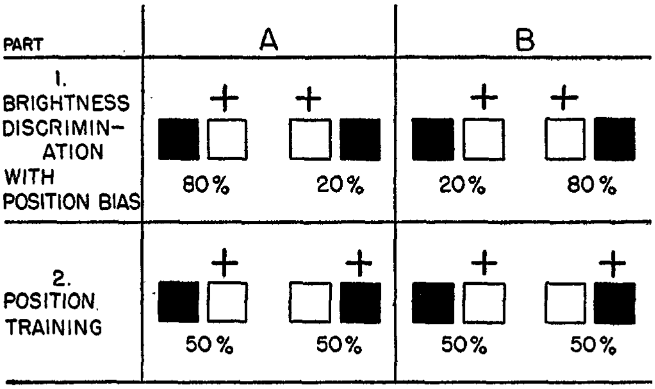

FIG. 1. ILLUSTRATION OF THE PROCEDURE EMPLOYED IN EXPERIMENT

The percentages represent the relative frequencies of presentation for each card arrangement during each stage of the experiment. 'Plus' signs designate the 'positive' cards.

Experiment I

Subjects: Twenty-two naive, four-month old Wistar rats were studied.

Apparatus: A grey-painted, two-window Lashley jumping apparatus was employed. The jumping-platform was wired so that shock could be administered to break resistance to jumping. Jumping to the correct card admitted the animal to a feeding-platform behind the windows. The negative card was locked in place so that an incorrect jump precipitated the animal into a net situated several feet below the windows.

Procedure: The two major phases of the experiment were preceded by a period of preliminary training. First, each animal was allowed to eat on the feeding-platform and then encouraged to walk from the jumping-platform through the open windows to food. On the following two days the animals were trained to jump gradually increasing distances, first to open windows and then to unobstructed grey cards which were painted the same color as the rest of the apparatus. A manual guidance procedure was employed to ensure that the animals would jump to both windows. Nevertheless, position preferences developed and these were recorded. Throughout the experiment the animals were kept on a 24-hour feeding schedule with a restricted diet of Purina chow.

Part I: Brightness Discrimination: On the fourth day, black and white cards were introduced and the animals were required to learn a brightness discrimination (white card positive and black negative for all animals). The typical training procedure was not employed, however, in that a position bias was introduced at the outset. The positive card was presented eight times on one side (which we shall call the 'biased' side) and only twice on the other during each daily series of ten trials. For half of the animals the biased side was the same as that for which they had manifested a preference in the preliminary training, while for the other half of the animals the biased side was opposed to that preference. A 'non-correction' procedure was employed in that a series of ten presentations was worked out in advance of each daily session, and the animal was allowed only one jump, correct or not, to each presentation. Functionally, of course, there was considerable opportunity for correction, since the biasing arrangement made it necessary to present one of the two card-arrangements four times in succession during each series of the trials. Presentation-orders of the following kinds were used (BW means black on the left and white on the right): BW, WB, WB, WB, WB, BW, WB, WB, WB, WB; WB, BW, WB, WB, WB, WB, BW, WB, WB, WB; *etc.* The criterion of learning was two successive errorless days (20/20). As soon as an animal reached the criterion, it was shifted (on the following day) to the problem of Part 2.

Part 2: Position Training: As each animal finished Part 1, it was assigned to one or the other of two experimental groups, A and B. These groups were matched for speed of learning of the discrimination problem. Further, the groups were approximately matched for the relation between the position biased in part 1 and the position preference manifested in the preliminary training. For 6 of the animals of Group A and 5 of the animals in Group B, the biased side was opposite the preference, while for 5 of the Group A animals and 6 of the Group B animals, the originally preferred side was biased. Since the original position preferences were very slight as a result of the preliminary training (very few animals jumped consistently to one side or the other during the preference tests) this slight difference in group composition should be of no consequence.

Position habits were now established in both groups. For Group A the position which had been biased (most frequently reinforced) during the discrimination training was positive. For Group B the previously biased side was negative. The black and white cards continued in use, but now each card appeared equally often on each side in accordance with the Gellerman series (4). The non-correction method was used as before. Ten trials per day were given, and the criterion of learning was two successive perfect days (20/20).

Results: Although both groups learned the brightness discrimination of Part 1 at an identical rate, when the problem was shifted from discrimination to position training the performance of the groups diverged significantly. In figure 2 the course of learning in terms of mean correct responses is plotted for both groups. In figure 3 a bar diagram shows the rate at which animals of the two groups reached the criterion of learning (two successive perfect days). Ten of the eleven Group A animals mastered the problem while only seven of the Group B animals succeeded. The training was terminated after 30 days (300 trials) because the remaining animals had taken up rigid abortive jumping patterns and there seemed to be no prospect that they would ever master the problem unless special conditions were introduced. The fact that more of the Group B animals failed to learn is itself an index of differential achievement which is in the same direction as the other indices. Mean trial and error scores based on the data for all of the animals in each group are presented in table 1. For the purpose of computing these means each animal which did not master the problem in 30 days was assigned a trial score of 300 and an error score which was the total number of errors made during the 30-day period. Festinger's test (3), which does not assume normality, indicates that Group A required a significantly smaller number of trials and made fewer errors in the course of the learning.

The behavior of the animals seemed to be highly situational rather than abstractive in character. When the previously established brightness preference became inadequate, the animals did not manifest a variety of new systematic

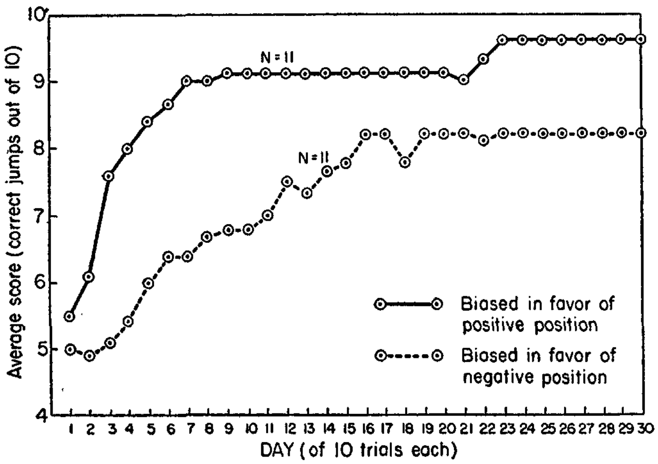

FIG. 2. THE ACQUISITION OF THE POSITION HABIT IN EXPERIMENT I

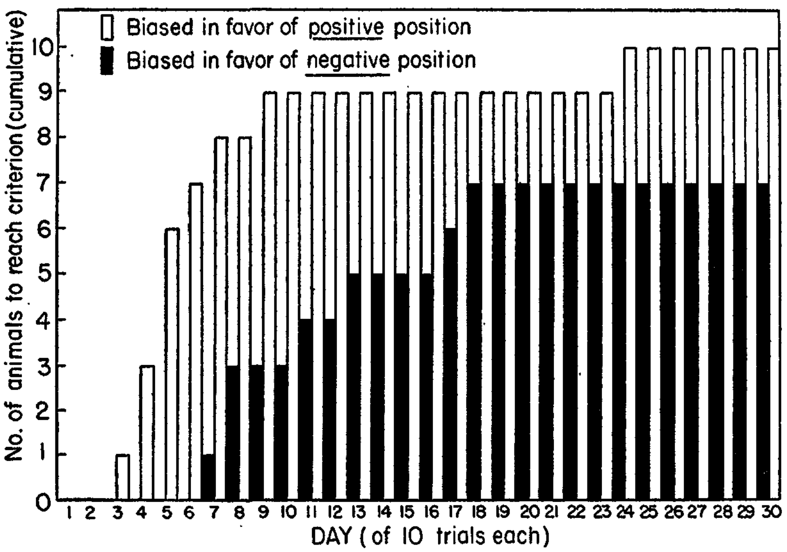

FIG. 3. THE ACQUISITION OF THE POSITION HABIT IN EXPERIMENT I

TABLE 1

Mean trials and errors required for the establishment of a position habit in Experiment I

MEAN	GROUP A N = 11	GROUP B N = 11	MEAN DIFF.	LEVEL OF SIGNIFICANCE*
trials	92.7	177.3	84.6	5%
errors	34.0	81.1	47.1	1%

* Festinger's test

response tendencies. Instead they continued to jump to the formerly positive card, readily when it appeared on the now positive side, and with increasing hesitance when it appeared on the negative side. The problem was mastered when the animal was able to reverse the direction of jump when presented with the previously incorrect card on the now correct side. For example, in the case of the animals whose training is illustrated in figure 1, a right jump continued to be correct in the black-left/white-right situation when the position training began. All of the animals continued to make this response on more than 99 per cent of the trials. The position training also required a right-going response in the situation white-left/black-right to which the animals had previously been trained to respond by going left. This reversal was more difficult for the animals of Group B and the fact that they reached the criterion less rapidly than did the animals of Group A can be entirely accounted for in this way. Apparently the difficulty of reversal was a direct function of relative frequency with which the earlier response had been reinforced. The results, therefore, are precisely those which continuity theory would have led us to expect.

In our opinion, these results would not have been predicted in advance of the experiment by the non-continuity theorist. Confronted with the actual data, however, he might conceivably offer something like the following explanation: In the first stage of the training (figure 1) right-going hypotheses would have been more often confirmed for animal A than for animal B; consequently, there would be a greater tendency for animal A to resort to a right-going hypothesis when the white-going hypothesis no longer is adequate. It also follows from this reasoning that there should be a greater tendency for animal B to resort to a *left*-going hypothesis, but there is no evidence that such was the case. Animal B jumped left when the white card was on the left, as did animal A, and B showed no greater tendency to jump left when the black card was on the left than did animal A (less than 1 per cent of the trials in each case). Now it may be that a jump to the left does not necessarily indicate a left-going hypothesis, but one can scarcely assume a left-going hypothesis where there has been no left jump. If animal B made a greater number of left-going hypotheses than did animal A, the difference must have been confined to the situation white-left/black-right. Non-continuity theory, as presently formulated, does not make it possible for us to predict or to understand a situational effect of this sort.

II. THE EFFECT OF 'SET'

Some years ago, Lashley (7) described what he considered to be a crucial test of the 'major hypotheses' involved in the controversy over the nature of discrimination learning. He wrote:

> "The question whether all stimuli acting at the time of response become associated with the response or whether the set of the animal determines a selective association can be tested by very simple experiments. If the animal is given a preliminary organization or set to respond to one component of a stimulus and is then trained in a situation where this component is combined with another, conditioned-reflex theory requires that both components be associated. The alternate theory predicts that no new association will be formed, provided that the new component does not arouse a perceptual organization dominant over the first" (pp. 257–258).

A number of experiments of this sort have been performed, but their results permit of a variety of interpretations. One of the principal problems relates to the question of whether the introduction of a given new component will 'arouse a perceptual organization dominant over the first.' The Spence (12) and Ehrenfreund (2) experiments demonstrate clearly that while the rat is responding systematically in terms of position it learns something about supplementary cues (brightness and form) which are differentially reinforced. But if, as Krechevsky (6) claims, systematic response to one cue is not in itself a guarantee that supplementary 'hypotheses' are not being employed, these experiments are deprived of crucial significance. It should be noted that the conditions employed by Spence and Ehrenfreund were conducive to the arousal of new sets as Lashley conceives of them. In each case the new stimulus aspects were introduced suddenly in the course of training in such a way as to facilitate perceptual reorganization. In each case, too, the new features appeared at a time when old sets—if they existed at all—were no longer entirely adequate; concurrently with the introduction of these features, frequency of reinforcement was reduced from 100 to 50 per cent. Although Lashley has not been clear on this point, he does at least in one place impose the condition that the old set must continue to be adequate after the new stimulus features are introduced.[1] The most severe possible test of the non-continuity position would be one which satisfied this condition. Furthermore, while the inadequacy of the already established position reaction set the stage for perceptual reorganization in the experiments of Spence and Ehrenfreund, no precautions were taken to prevent the development of consistently successful supplementary hypotheses in the experimental groups. These animals were consistently rewarded in relation to one brightness or form and never rewarded in relation to the alternative cue.

Some of the same problems confront us when we attempt to interpret the results of the experiment by Blum and Blum (1). The sudden change in form introduced in the course of this experiment might conceivably have produced perceptual reorganization, as the Blums themselves suggest. That this possibility must be taken more seriously than they recognize is indicated by the fact that two of their five animals failed to carry over the size response when the triangles were introduced and therefore required retraining. On the other hand, 'several experiments' conducted by Lashley (7) under similar conditions produced non-continuity results in all but one instance. Lashley accounts for the exception in terms of perceptual reorganization. Continuity theorists account for his non-continuity results in terms of 'receptor orientation' and appeals to as yet unmeasured generalization gradients (1, 8, 11, 12).

The second experiment to be reported here was designed to study the effect of an established 'set' under conditions which eliminate insofar as possible the possibility of perceptual reorganization. It is based upon the technique of differentially reinforcing supplementary cues which was employed in Experiment I, except that the differential reinforcement is introduced following the learning rather than at the outset of the training. The procedure is illustrated schematically in figure 4. Suppose that two animals, A and B, learn a right-going response to food in the V-shaped maze which is diagrammed. The arms of the maze are painted black and white, and they are interchanged randomly in the course of the learning. When the problem is mastered, the animals are given a further series of 40 trials. The established position response remains correct and continues to be reinforced at the 100 per cent level. The black and white alleys are used as before in this second phase of the experiment, but biased reinforcement with respect to brightness is introduced. For animal A the white alley appears on the right side on 80 per cent of the trials and left on 20 per cent of the trials. The reverse bias is employed for animal B. In the third part of the experiment, which follows the 40 trials of Part 2, the problem is shifted to brightness discrimination with white positive irrespective of position, and again the alleys are interchanged in random fashion. How will the performance of the two animals compare?

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[1] He writes (7, p. 259): "If the animals are given a set to react to one aspect of a stimulus situation, large amounts of training do not establish association with other aspects, so long as the original set remains effective for reaching the food."

Non-continuity theory suggests that the two animals will master the brightness problem at the same rate. A set for position has been established in Part 1 which continues to be completely adequate (and more adequate than any other possible set) in Part 2. There is no reason, therefore, for the appearance of new hypotheses. Furthermore, no new stimulus features have been introduced which might make for perceptual reorganization. From the point of view of continuity theory, on the other hand, we are required to predict superior performance for animal A.

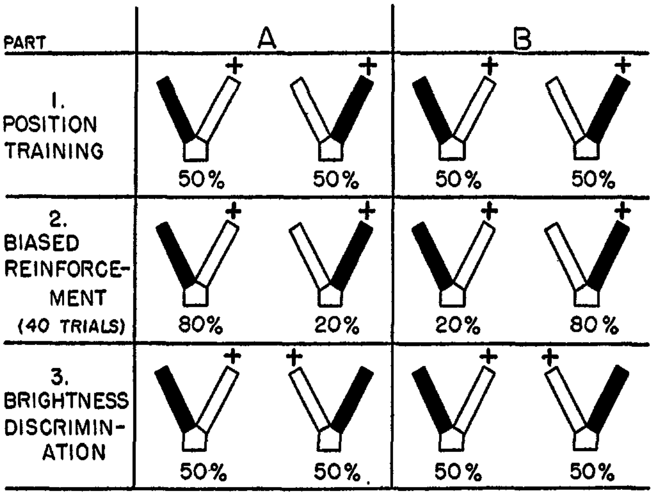
PART
A
B
1. POSITION TRAINING
+
50%
50%
50%
50%
2. BIASED REINFORCEMENT (40 TRIALS)
80%
20%
20%
80%
3. BRIGHTNESS DISCRIMINATION
50%
50%
50%
50%

FIG. 4. ILLUSTRATION OF THE PROCEDURE EMPLOYED IN EXPERIMENT II

The percentages represent the relative frequencies of presentation for each spatial arrangement of the alleys during each part of the experiment. 'Plus' signs designate the 'positive' alleys.

Experiment II

Subjects: Eighteen naive, four-month old Wistar rats were studied. The animals were divided into two groups, A and B, matched for sex and litter.

Apparatus: A V-shaped elevated maze with a starting-platform at the base of the V and a feeding-platform at the end of each arm was employed. The entire structure was painted grey. On the top of the runways, which were 2 inches wide and 4 feet in length, it was possible to mount supplementary runways of the same dimensions which were painted white on one surface and black on the other. A simple pivot arrangement enabled the experimenter to reverse the brightness aspect of these paths for the purpose of discrimination training. The starting-platform was equipped with a plexiglass door which restrained the animal until the beginning of each trial. The feeding-platforms were equipped with sunken food cups which could be covered or not depending upon whether or not a given runway was correct on any trial. The presence of a cover on a cup could not be detected by the rat until it reached the end of the runway.

Procedure: The three major parts of the experiment were preceded by a period of preliminary training. Grey runways were used and both food cups were open. The animals were allowed to feed alternately from both cups during the first two days. On the third day running was encouraged by allowing the animals to approach the food cups from points successively nearer the starting platform. On the fourth day each animal was given ten trials from the starting-platform and a record of position preferences was made. Throughout the entire experiment the animals were kept on a 24-hour feeding schedule with a restricted diet of Purina chow.

Part 1: Position Training: On the fifth day the black and white alleys were introduced, and each animal was trained opposite to its originally manifested position preference. Brightness was alternated randomly in accordance with the Gellerman orders (4). No punishment was administered for incorrect choice. The food cup on the incorrect side was covered, and each trial terminated when the animal finally reached the exposed food on the correct side. That is, having made an incorrect choice, the animal could return to the choice-point and run to the other side, although the plexiglass door prevented it from returning to the starting-platform. Each animal was given ten trials per day, and training was continued to a criterion of 9/10 correct choices on a given day. An error consisted of placing all four feet on the incorrect pathway. Only one error could be made on each trial—each trial was scored as either correct or incorrect.

Part 2: Position Training with Biased Reinforcement: This stage of the training required four days, ten trials per day. The position preference established in the preceding stage continued to be correct, but now a brightness bias was introduced. Previously each brightness (black and white) had appeared equally often on each side. Now, however, the black-white ratio was changed from 50–50 to 80–20. For half of the animals in each group white appeared on the correct side eight times and black twice in each series of ten trials, and the reverse was true for the other half of the animals in each group. The orders illustrated in connection with Experiment I were employed. Thus, during the second part of the experiment (40 trials) each animal was reinforced 32 times on one brightness and 8 times on the other. All of the animals continued to run predominantly to the correct side, with no animal falling below the 9/10 level on any day.

Part 3: Brightness Discrimination: In the third part of the experiment all of the animals were required to learn a brightness discrimination. For Group A the brightness which had been more frequently reinforced in Part 2 was correct. For Group B the brightness which had been less frequently reinforced was correct. The position of the correct alley was alternated randomly in accordance with the Gellerman series. As before, correction of errors was permitted, and an error consisted of putting all four feet on the incorrect pathway. The criterion of learning was again 9/10 correct choices on any one day.

Results: The position habit was established with equal ease in both groups (an average of about 25 trials) in the first phase of the experiment, and all animals continued to run to the established position (no animal less than 9/10 on any day) during the subsequent 40 trials in which the brightness bias was introduced. But the performance of the two groups diverged significantly when the problem was shifted to brightness discrimination in Part 3. The data on discrimination learning are presented in table 2. Festinger's test (3) reveals that the performance of Group A was superior to that of Group B both in terms of trials and in terms of errors. It should be noted that the means for Group B are based on data for only eight animals, because one of the rats of this group became disturbed when the problem was shifted. It responded sluggishly and at a chance level during the first 100 trials, after which it was discarded when it developed a tendency to leap from the maze onto the floor. If the data for this animal had been included, the relative superiority of Group A would have been *increased.*

Learning curves for the two groups are plotted in figure 5. The criterion of learning was 9/10 correct trials on any given day, and work with each animal was discontinued after it had reached this criterion. For the purpose of plotting the group curves, however, it was assumed that the animal would have made perfect runs on all subsequent days. The data for both groups were of course treated in an identical manner.

A further analysis of the course of learning in Part 3 clearly shows that non-continuity theory is incorrect insofar as it assumes that in mastering a discrimination problem the rat abstracts some feature of the stimulus situations which are presented and reacts to it independently of its perceptual context. If we examine the performance of the animals in each of the two situations with which they were confronted in the course of the discrimination learning—black-left/white-right and white-left/black-right—the inadequacy of 'hypothesis' theory is revealed. Such an analysis shows that the two situations are not functionally equivalent for the animal—that the selection of the correct response in each situation proceeds at a different rate depending on the extent and nature of the animal's previous experience with that situation.

TABLE 2

Mean trials and errors required for mastery of the black-white discrimination in Experiment II

MEAN	GROUP A N = 9	GROUP B N = 8	MEAN DIFF.	LEVEL OF SIGNIFICANCE*
trials	110.0	152.5	42.5	5%
errors	41.3	68.0	26.7	1%

* Festinger's test

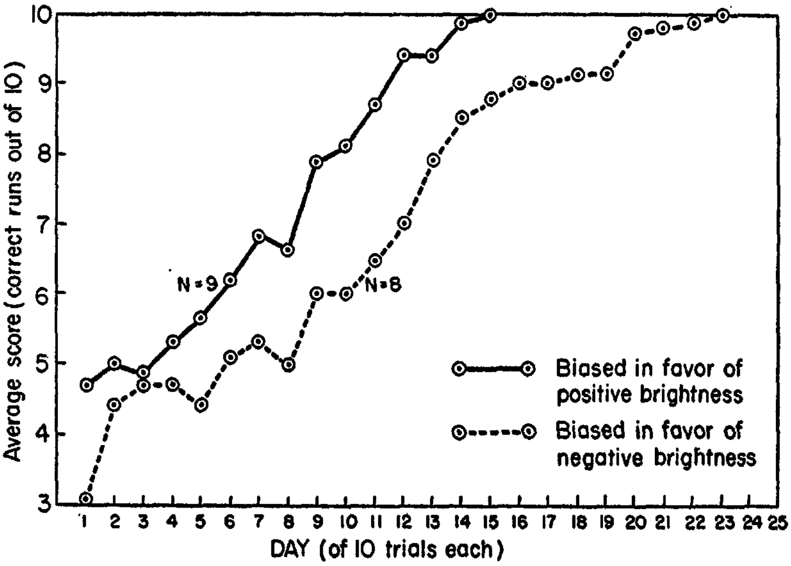

FIG. 5. THE COURSE OF BRIGHTNESS DISCRIMINATION IN EXPERIMENT II

Each animal faced the same two physical situations in both major phases of the experiment (position training and discrimination training). Shifting from a position response to a brightness response required the animal to reverse the previously established reaction in one of these situations and not in the other.

The animals whose training is illustrated in figure 4, for example, were required to reverse the previous response to white-left/black-right when the problem was shifted, while the response to black-left/white-right remained correct. Now if

TABLE 3

Situational analysis of the course of discrimination in Experiment II

SITUATION	GROUP	MEAN ERRORS	MEAN DIFF.	LEVEL OF SIGNIFICANCE*
Frequent reinforcement, non-reversal	A	11.0	10.8	1%
Infrequent reinforcement, non-reversal	B	21.8	11.5	5%
Infrequent reinforcement, reversal	A	33.3	12.0	1%
Frequent reinforcement, reversal	B	45.3		

* Festinger's test

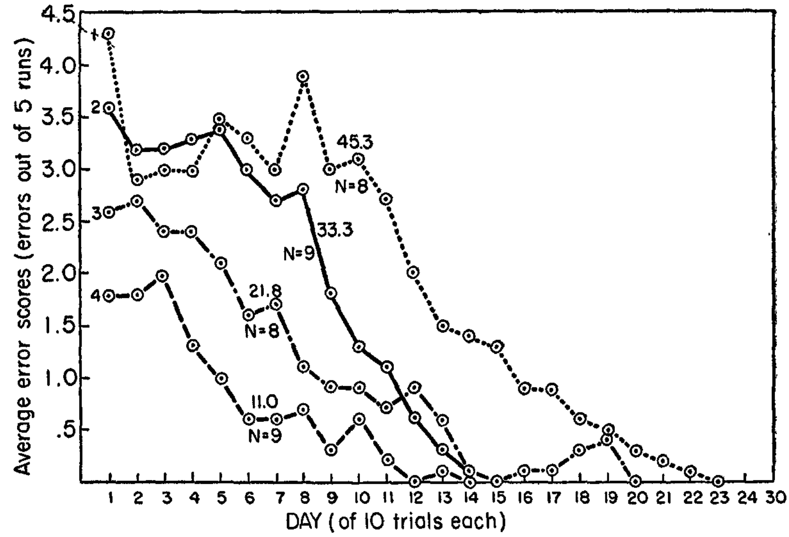

FIG. 6. SITUATIONAL ANALYSIS OF ERROR ELIMINATION IN THE BRIGHTNESS DISCRIMINATION PROBLEM OF EXPERIMENT II

Curve 1: Reversal of a frequently reinforced response.
Curve 2: Reversal, infrequent reinforcement.
Curve 3: Non-reversal, infrequent reinforcement.
Curve 4: Non-reversal, frequent reinforcement.
Mean error scores corresponding to each curve are shown.

the animals had been reacting abstractly during the position training—that is, if they had been reacting in terms of a single stimulus feature (position) abstracted from both arrangements—we should have expected their performance in both situations to be equally disturbed when a shift in the problem made it necessary for them to cast about for new 'hypotheses'. Actually, however, their performance was differentially affected depending upon how frequently each situation had previously been encountered and upon whether or not a reversal of a previously established response was required. This phenomenon may be seen in figure 6. The four error curves show the course of discrimination learning in the two groups separately for each situation. These curves may be understood in terms of the sample procedure outlined in figure 4. In the discrimination problem each Group B animal was required to *reverse* a response to one of the situations (in this case, white-left/black-right) which had been *frequently* reinforced during the position training. Progress in the reversal is plotted in curve 1. Each animal in this group was also required during the discrimination training to carry over a response to the second situation (black-left/white-right) which had previously but *infrequently* been reinforced (curve 3). Each animal of Group A was required to *reverse* a previously but *infrequently* reinforced response to one of the situations (in the sample case, white-left/black-right). The course of this reversal training is shown in curve 2. Each animal of Group A was also required to respond as before to a situation (black-left/white-right) previously very *frequently* encountered (curve 4). The rate of learning under these four different conditions varied significantly. Mean errors are presented in table 3. These data show that under the conditions of this experiment, the animals learned the brightness discrimination situationally rather than by abstracting the relevant stimulus feature. For the animals of both groups black-left/white-right and white-left/black-right functioned as discrete situations. Adjustment to each developed at a different rate depending upon whether or not the previously rewarded response continued to be correct and how frequently the previously established response had been rewarded. Continuity theory, by taking into account all of the forces which operate in each situation confronting the animal, is better able to deal with data of this kind.

SUMMARY AND CONCLUSIONS

Two experiments are reported which were designed to test the continuity and non-continuity theories of discrimination learning in the rat. In Experiment I the Lashley jumping apparatus was employed. While the animals were learning a black-white discrimination the spatial cues were differentially reinforced. This differential reinforcement was found to influence the subsequent learning of a position response. In Experiment II an elevated V-maze with black and white alleys was employed. After a position response was developed under conditions of random alternation of the position of the two alleys, differential black-white reinforcement was introduced while the position response continued to be consistently correct. This differential reinforcement influenced the subsequent learning of a black-white discrimination. In both experiments differentially reinforced irrelevant cues acquired functional significance under conditions which did not permit the consistent confirmation of 'hypotheses' about them. In the second experiment the irrelevant cues acquired significance despite the fact that the animals had already achieved a consistently successful mode of response to the situation. The results of both experiments confirm predictions made in terms of continuity theory.

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